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REDESCRIPTION OF A NORTH AMERICAN FRESHWATER PLANARIAN, *SEIDLIA REMOTA* (SMITH, 1988), WITH TAXONOMIC NOTES ON *SEIDLIA* AND *POLYCELIS* SPECIES FROM THE FAR EAST AND CENTRAL ASIA (TURBELLARIA, SERIATA, TRICLADIDA, PALUDICOLA)[1)]

by

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INTRODUCTION

A Eurasian genus *Polycelis* EHRENBERG, 1831, in the family Planariidae STIMPSON, 1857, of freshwater planarian has over 30 species and several subspecies in Europe, Central Asia, the Far East, and the United States. The genus is, however, not homogeneous according to details of the genital anatomy and histolgy (especially in the anatomy of the copulatory apparatus).

The Russian taxonomists (ZABUSOV, 1911, 1916, ZABUSOVA, 1929, 1936; LIVANOV & ZABUSOVA, 1940) proposed the 5 generic classification system: *Polycelis* EHRENBERG, 1831; *Sorocelides* ZABUSOVA, 1929; *Polycelidia* ZABUSOVA, 1936; *Seidlia* ZABUSOV, 1911; *Ijimia* BERGENDAL, 1890. KENK (1930, 1953, 1972, 1973, 1974, 1989) proposed the 3 subgeneric classification system: *Polycelis* (syn. *Sorocelides* and *Polycelidia*), *Seidlia* and *Ijimia* (cf. KAWAKATSU, OKI, TAMURA, TAKI, YAMAMOTO, NISHINO, TIMOSHKIN, KUZNEDELOV & SLUYS, 1996, p. 16).

The main subgeneric characters in KENK's (*op. cit.*) system are: 1) *Polycelis* (lacking adenodactyls and lacking excessive development of the muscle coat of the male genital antrum); 2) *Seidlia* (having an extraordinarily thick muscle zone surrounding the male genital antrum and without adenodactyls); 3) *Ijimia* (possessing solid adenodactyls and without thick muscle zone of the male genital antrum).

KAWAKATSU & MITCHELL (1995) considered that the subgenus *Seidlia* should be recognized at the rank of genus to which it was elevated by ZABUSOVA in 1936. According to this new taxonomic system, the genus *Polycelis* (*s.l.*) is separable as follows: the genera *Polycelis* EHRENBERG, 1831 (consists of the subgenera *Polycelis* EHRENBERG, 1831, and *Ijimia* BERGENDAL, 1890) and *Seidlia* ZABUSOV, 1911.

The species of the subgenus *Polycelis* show a wide geographical distribution in Europe, Central Asia, the Far East, and the United States. The species of the subgenus *Ijimia* is distributed only in Europe (a single species is distributed in New Guinea). The *Seidlia* species are distributed in Central Asia, the Far East and United Staes.

The first *Seidlia* species reported from the United States was *Seidlia sierrensis* (KENK, 1973) (*olim Polycelis* (*Seidlia*) *sierrensis*) from California and Nevada. In 1988, a new species, "*Polycelis remota* SMITH, 1988", was described from a spring in Western Massachusetts. KAWAKATSU felt that misunderstandings of penial anatomy appeared in the original description (Biol. Bull., 175, fig. 2 on p. 248; parts of the organ represented as PV, ED, PB, and PP are incorrectly interpreted). We studied newly-prepared serial sections of "*Pol. remota*" from the type locality (obtained by the courtesy of Dr. D. G. SMITH). Microscopic examination revealed that the species is the second *Seidlia* species occurring in the United States.

In the present paper, a taxnomic redescription of *Seidlia remota* (SMITH, 1988) will be given first. Following, taxonomic notes on *Seidlia* and *Polycelis* species from the Far East and Central Asia will be given because several new species (including synonyms) in these genera have

1) Parts of this paper were given at the 66th Annual Meeting of the Zoological Society of Japan held in Hachiôji, Tôkyô, Japan (September 15–17, 1995; cf. KAWAKATSU & MITCHELL, 1995) and the VIIIth Internationl Symposium on the Biology of Turbellaria held in Brisbane, Australia (August 19–23, 1996; cf. KAWAKATSU & TIMOSHKIN, 1996, 1998; see also KAWAKATSU, OKI, TAMURA, TAKAI, YAMAMOTO, NISHINO, TIMOSHKIN, KUZNEDELOV & SLUYS, 1996).

been reported after publication of KENK's "Index of the Genera and Species of the Freshwater Triclads (Turbellaria) of the World (1974)."

MATERIAL AND METHODS

The following samples of "*Polycelis remota*" were examined.

KAWAKATSU's Specimen Lot No. 1985. About 20 sexual and asexual specimens collected from the type locality : a spring in Sunderland, Franklin County, Massachusetts, U. S. A. (see SMITH, 1988, p. 246) ; fixed with FAA and then presently in 3% formalin solution. Coll. Dr. D. G. SMITH ; November 7, 1989.

Serial sections (7-8 micrometers) of 13 specimens stained with Delafield's hematoxylin and erythrosin were prepared by KAWAKATSU. Whole mounts of 2 specimens (a single specimen without staining and another specimen stained with erythrosin) were also prepared for stereomicroscopic examination.

REDESCRIPTION OF "*POLYCELIS REMOTA* SMITH, 1988"

Order TRICLADIDA
Suborder PALUDICOLA or PROBURSALIA
Family PLANARIIDAE STIMPSON, 1857
Genus *Seidlia* ZABUSOV, 1911
Seidlia remota (SMITH, 1988)

Principal literature.

Polycelis remota SMITH, 1988, in Biol. Bull., 175 : 246–252, figs. 1–3. Original description.

Seidlia remota in KAWAKATSU & MITCHELL, 1995, Zool. Sci., Tôkyô, 12–Suppl.: 32. Taxonomic remarks.

External features. External appearance of live specimens of this species with sketch figures is described by SMITH (1988, p. 247, fig. 1 A–C; see Fig. 1 A–C in the present paper). Preserved sexually mature specimens measure 9 to 12mm long and 1.5 – 2.5 mm in width. The head is gently convex with moderately-developed, prominent auricles (Figs. 2 A–C, 3 A and B). Behind the head, the "neck" is conspicuous.

The ground color of the dorsal side of the body is pale redish brown. The ventral side is a lighter hue. A pharynx is inserted somewhat behind the middle of the body. The copulatory organs occupy more than the anterior one-third of the post-pharyngeal region, so that the genital pore opens to a slightly anterior level (Figs. 2 A–C, 3).

SMITH (1988, p. 247, fig. 1 D ; see Fig. 1 D in the present paper) described a presence of "a single exterior sucker-like organ situated always on the right ventral side of the animal, anterior and separate from the gonopore and its associated atrial cavities." However, no such structure was found in our samples examined (this is also confirmed by the examination of our serial sections).

The species has many small eyes near the anterior and the lateral margins of the head (Figs. 2A, 3 A and B ; see also Fig. 1 A–C). The eyes in a curved band of two to three rows are absent at the top of the frontal margin and the basal portions of the auricles ; behind the level of auricles, the band narrows to a single row that terminating at the anterior one-third level of the prepharyngeal region. The variations of number of eyes are shown in Table 1.

Judging from our data, the general arrangement of eyes in *S. remota* is different from that of North American *Seidlia sierrensis* KENK, 1973 (cf. KENK, 1973, p. 9, fig. 6 C). It is also different from that of 3 Japanese *Seidlia* species : *Seidlia auriculata* IJIMA et KABURAKI, 1916 (cf. KAWAKATSU, TESHIROGI & ISHIDA, 1980, p. 132, fig. 1) ; *Seidlia akkeshi* (cf. ICHIKAWA & KAWAKATSU, 1963, pp. 1–3, figs. 1 A–E and 2 A–F) ; *Seidlia schmidti* (ZABUSOV, 1916) (cf. KAWAKATSU, 1964, pp. 176–177, figs. 1 A–C and 2 A–F ; KAWAKATSU & YAMADA, 1966, p. 3, fig. 1 a–h).

Internal features. The pharynx has a structure typical of the genus *Seidlia* in the family Planariidae. The anterior intestinal trunk has about 10 short lateral branches ; each posterior trunk has 12 to 15 short branches. In large specimens, two medial branches are united at the middle level of the copulatory apparatus (between the penis and the genital pore on the ventral side) and from a well-developed intestinal anastomosis. It is a wide canal lined with a very high, highly glandular epithelium. The muscular coating of the canal consists chiefly of a thick

Table 1. Variation of the number of eyes in *Seidlia remota* from the type locality (KAWAKATSU's Specimen Lot No. 1985).
The body length was measured from the preserved specimens.

No. of specimens examined, their sexual state in parentheses	Body length × width (mm)	No. of eyes		
		Minimum on one side	Maximum on one side	Total no. of eyes
15(13, sexual	8–11 × 1.5–2	28	42	57–82
2, asexual	4–5 × 1	16	35	33–65

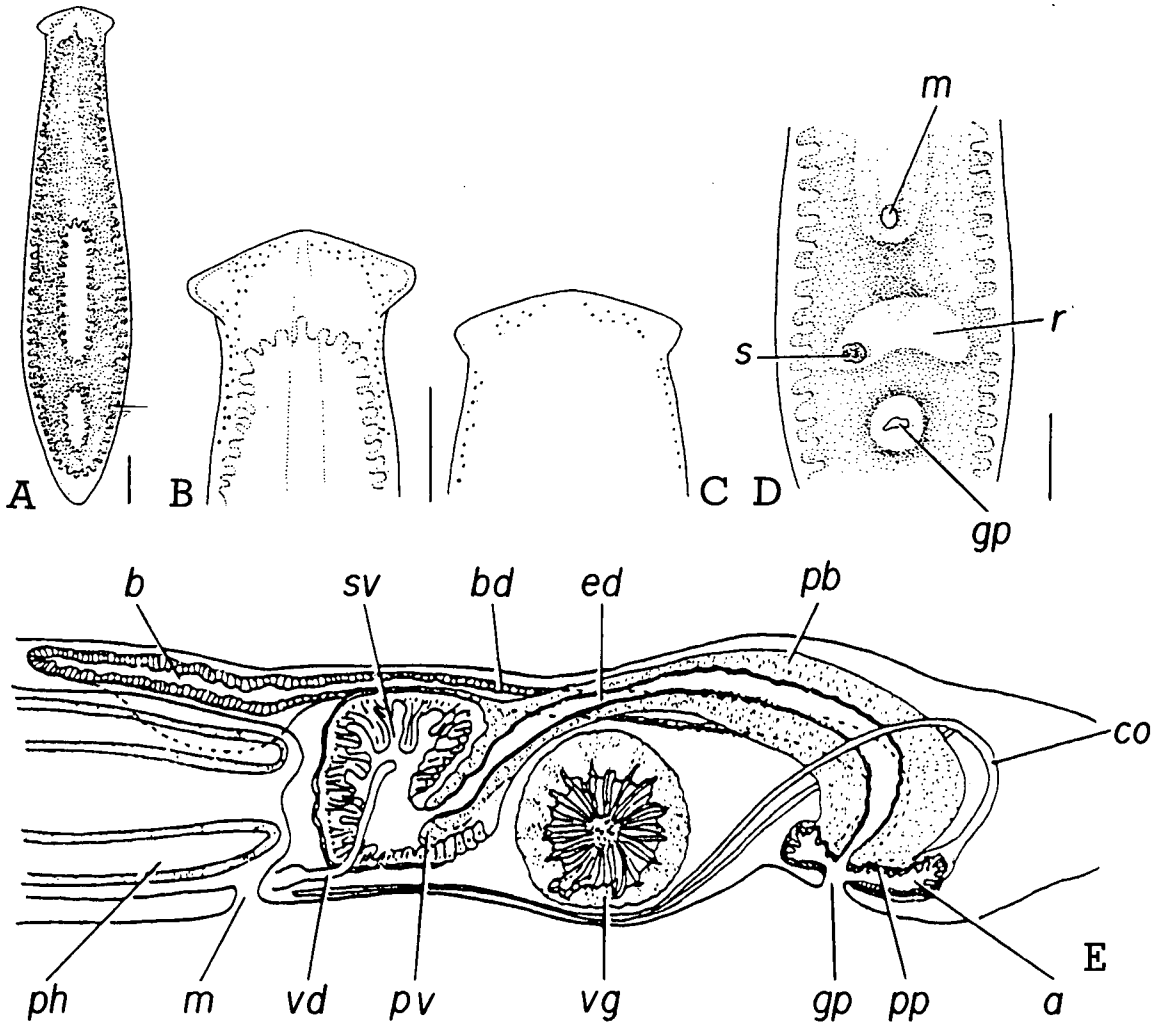

Fig. 1. "*Polycelis remota* SMITH, 1988", external characteristics (A—D) and a sagittal view of the copulatory apparatus (E) (after SMITH, 1988 ; slightly retouched). A, dorsal view of a living specimen ; B, anterior end of a living specimen ; C, anterior end of a preserved specimen ; D, ventral view of the posterior portion of a preserved specimen. Scale, 1 mm. E, sagittal view of the copulatory apparatus of the holotype. Original abbreviations are used (for the new abbreviations shown in parentheses, see explanations in Fig. 4). *a*, atrium (ca) ; *b*, bursa (cb) ; *bd*, bursa duct (bs) ; *co*, common oviduct (cod) ; *ed*, ejaculatory duct (ma) ; *gp*, gonopore (gp) ; *m*, mouth pore (m) ; *pb*, penis bulb (mz) ; *ph*, pharynx (ph) ; *pp*, penis papilla (terminal portion of the mz) ; *pv*, papilla of vesicle (pp) ; *r*, region of ventral gland (ia) ; *s*, sucker (misunderstanding) ; *sv*, seminal vesicle (bc) ; *vd*, vas deference or narrowed spermiductal [sic] vesicle (sd) ; *vg*, ventral gland (ia).

layers of transverse and circular fibers. Numerous erythrophilic glands lie in the surrounding parenchyma and their outlets penetrate the muscular layer and the inner epithelium (Figs. 4 A–C, 5 A–C ; see also Fig. 1 E). A more detailed histology of this organ was found in the original description as "ventral gland" (cf. SMITH, 1988, p. 248, fig. 2, p. 250, fig. 3 b–c).

In histological sections, the moderately large, prepharyngeal testes are arranged in two longitudinal zones, adjacent to each side of the anterior intestinal trunk ; they can be seen in preserved specimens (Fig. 2 B and C). They are essentially ventrally located. A pair of ovaries is situated in the usual anteroventral position. Yolk glands are found in dorso-lateral parenchyma on both sides.

Fig. 2. *Seidlia remota* (SMITH, 1988), photographs of two preserved specimens (Lot No. 1985). A and B, dorsal (A) and ventral (B) views of the same specimen ; C, ventral view of another specimen. Notice the prepharyngeal testes found in photographs B and C ; a pair of spermiducal vesicles can also be seen in the former.

SMITH (1988, p, 248) gave descriptions of anatomy and histology of the copulatory apparatus of *"Pol. remota"* with its schematic figure in sagittal view (*loc. cit.*, fig. 2). The reproduction of his figure is shown in Fig. 1 (E) of the present paper. Our newly prepared sagittal views of the copulatory apparatus of 2 specimens are shown in Fig. 4 (A–C). Pertinent photomicrographs of the apparatus are shown in Fig. 5 (A – C).

The penis consists of a large bulb embedded in the parenchyma and a rather small papilla projecting into the beginning of the male genital antrum. The penis bulb is a napiform organ (Fig. 4 A ; sometimes irregular form in shape as shown in Fig. 4 C) and contains a wide bulbar cavity lined by a tall, glandular epithelium. The bulb is pierced many ducts of erythrophilic glands. The two sperm ducts open into the bulbar cavity separately from the antero-lateral sides. The spermiducal vesicles are well-developed in this species (Fig. 4 A and C).

The penis papilla has a short, nearly symmetric and turbinate in shape (Figs. 4 A and C, 5 A and C). A narrow, tubular ejaculatory duct opens at the tip of the papilla. The outer wall of the papilla is lined with a thin epithelium of a nucleate type. The musculature of the papilla is weakly developed. It is noticed in the original description of this species that the structure of the penis papilla and ejaculatory duct were overlooked (cf. SMITH, 1988 ; see Fig. 1 E in the present paper).

The species has an extraordinarily thick muscle zone surrounding the middle and posterior sections of a tubular male antrum that opens into the common genital antrum closely near to the genital pore. The lumen of the male antrum is lined with a cubical, glandular, nucleate epithelium (it is especially well developed in the middle section than other parts). As shown in Fig. 4 (A and C ; see also Fig. 5), the posterior end of this muscular organ is bluntly pointed or rounded (so that this part

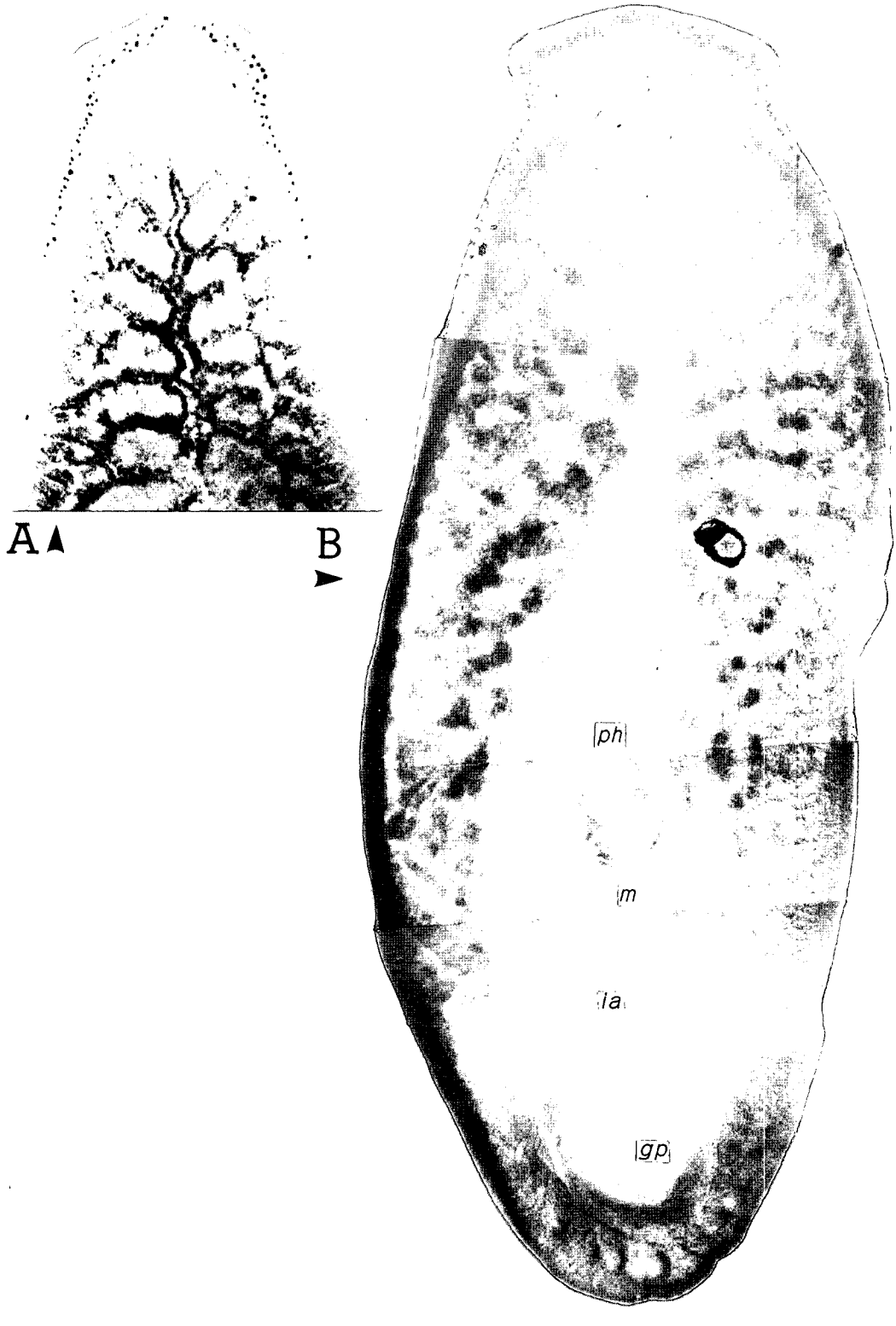

Fig. 3. *Seidlia remota* (SMITH, 1988), photomicrographs of whole-mounted specimens. Notice the arrangement of eyes. A, head (No. 1985-n ; non-stained sample) ; B, whole body (N0. 1985-o ; light stained sample with erythrosin). ia, intestinal anastomosis ; gp, genital pore ; m, mouth ; ph, pharynx.

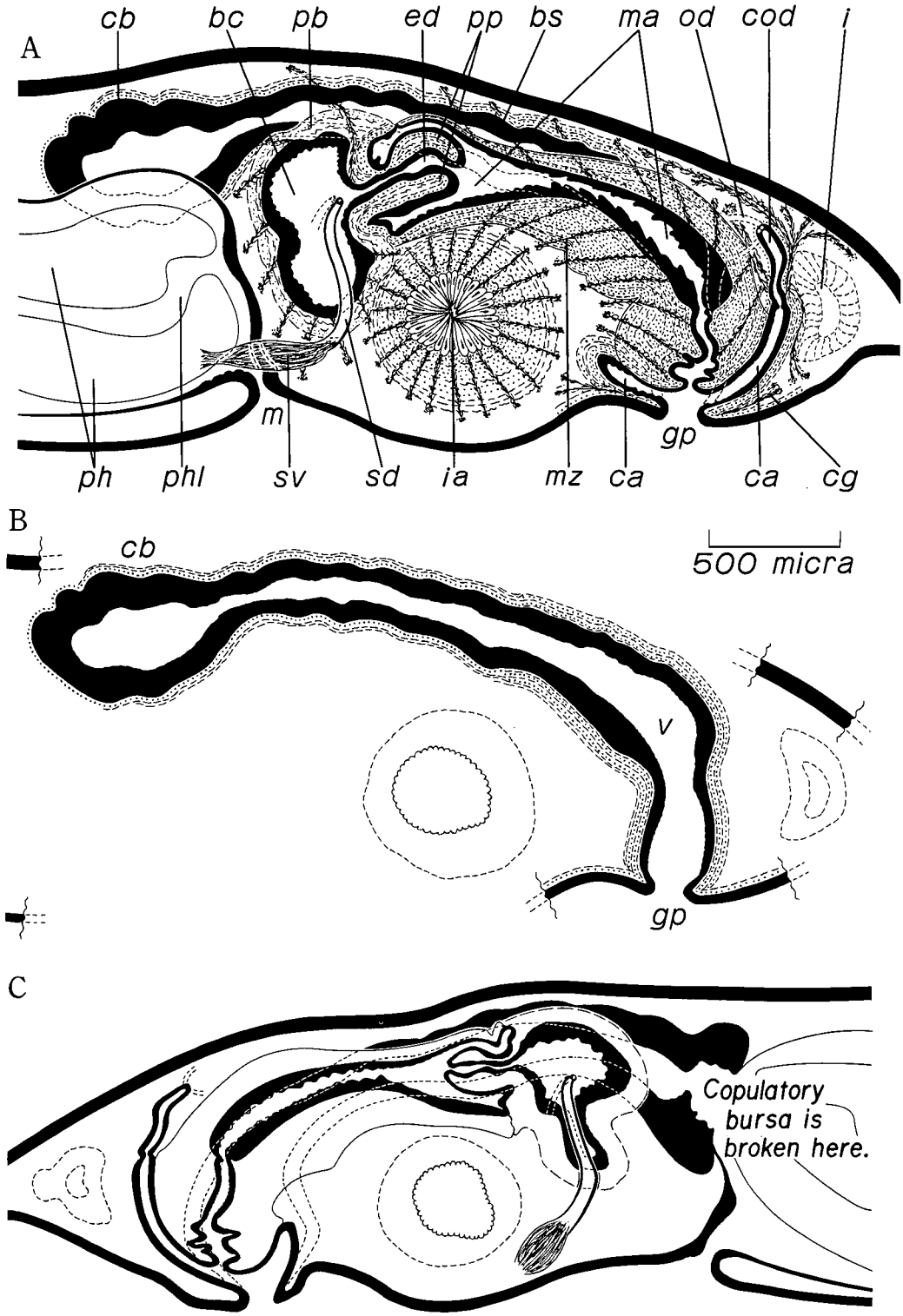

Fig. 4. *Seidlia remota* (SMITH, 1988), semidiagrammatic sagittal views of the copulatory apparatus of 2 specimens from the type locality. A and B, No. 1985-h (copulatory bursal and bursal stalk are shown separately) ; C, No. 1985-i bc, bulbar cavity ; bs, bursal stalk ; ca, common genital antrum ; cb, copulatory bursa ; cg, cement glands ;

Fig. 5 (continued in the next page).

cod, common ovovitelline duct ; ed, ejaculatory dyct ; gp, genital pore ; i, intestine ; ia, intestinal anastomosis ; m, mouth ; ma, male genital antrum ; mz, muscle zone surrounding the male genital antrum ; od, ovovitelline duct ; pb, penis bulb ; ph, pharynx ; phl, pharynx lumen ; pp, penis papilla ; sd, sperm duct ; sv, spermiducal vesicle ; v, vagina.

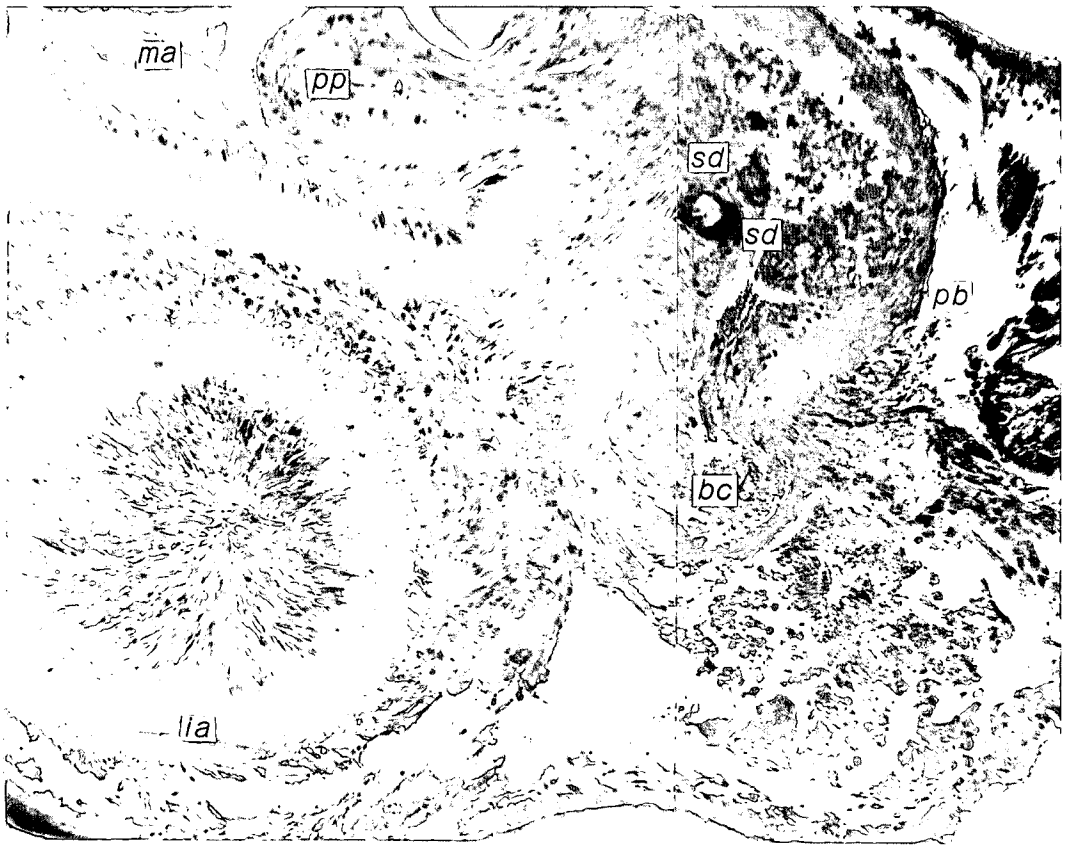

Fig. 5 (on pp. 101-102). *Seidlia remota* (SMITH, 1988), photomicrographs of near midsagittal sections of the copulatory apparatus. A, No. 1985-h (anterior is the left) ; B and C, No. 1985-i (anterior is the right). bc, bulbar cavity ; bs, bursal stalk ; ca, common genital antrum ; cb, copulatory bursa ; cod, common ovovitelline duct ; ed, ejaculatory duct ; ia, intestinal anastomosis ; m, mouth ; ma, male genital antrum ; pb, penis bulb ; ph, pharynx ; phl, pharynx lumen ; pp, penis papilla ; ps, penis sheath (*i. e.*, muscle zone surrounding the male genital antrum) ; sd, spermiducal vesicle.

was misunderstood as penis papilla in SMITH's 1988 paper). Histolgically, the musculature consists of thin layers of longitudinal fibers and a very thick layer of circular fibers (Figs. 4 A, 5 A and C).

The common ovovitelline duct is rather long and conspicuous. It opens into the terminal portion of the common antrum from the postero-dorsal side (Figs. 4 A and C, 5 B).

The copulatory bursa is moderate in size and is situated in a dorsal position between the posterior end of the pharyngeal chamber and the anterior side of the penis bulb. From the postero-dorsal side of the bursa a wide and long bursal stalk proceeds posteriorly and opens, from the dorsal side, into the terminal portion of the common antrum, immediately near the genital pore (Figs. 4 A–C, 5 A–C). The bursal canal is lined with a tall, glandular, nucleate epithelium. Below this epithelium, there is a thin layer of circular muscle fibers and a thin layer of longitudinal ones. The posterior one-third of the bursal canal forms a thick-walled vagina. The thick muscle coat surrounding the vagina consists of three layers : an inner, thin layer of longitudinal fibers ; a middle, thick layer of circular and longitudinal fibers intermingled ; and an outer, slightly thickend layer of longitudinal fibers.

Differential diagnosis. Seidlia remota differs from the other members of the genus in the following characters : living animal moderate in size, rather slender, and pale redish brown above in color ; head gently convex with moderately-developed auricles ; curved eye-bands separated at the top of the frontal margin and each of them terminating at the anterior one-third level of the prepharyngeal region ; possessing a well-developed anastmosis ; penis bulb

large and weak muscular with wide bulbar cavity into which each sperm duct enters separately from the anterolateral sides ; turbinate, symmetric penis papilla short and weak muscular with a narrow ejaculatory duct ; with an extraordinarily thick muscle zone surrounding the male genital antrum ; common ovovitelline duct long which enters into the roof of the posterior terminal part of the common genital antrum ; copulatory bursa moderate, with long, rather wide bursal stalk, of which posterior section of the bursal canal forms a thick-walled vagina.

Material. See the section "Material and Methods". Thirteen sets of serial sagittal, transverse and horizontal sections (KAWAKATSU's Specimen Lot No. 1985 : –a, –b, –c, –d, –e, –f, –g, –h, –i, –j, –k, –l, –m) and 2 whole mounts (–n, –o) are retained in KAWAKATSU's collection. Some of the sections separated from this collection will be sent to the Department of Zoology (Nat. Hist.), National Science Museum of Natural History, Tôkyô, Japan.

Taxonomic Notes on *Polycelis* and *Seidlia* Species from the Far East and Central Asia

Asia has a rich fauma of the *Polycelis* and *Seidlia* species (cf. KENK, 1953, 1974). Moreover, during the past 10+ years, several new *Polycelis* (*s. l.*) species were described in this geographical area of Asia. Every known Asiatic species of the genera *Polycelis* and *Seidlia* are listed below with their distribution areas and short taxonomic remarks. For *Polycelis* (*P.*) *sapporo* and *Seidlia schmidti* from the Far Eastern Area, the latest distribution data (including maps showing their geographical distribution) were described in a recent paper by KAWAKATSU & TIMOSHKIN (In press).

Worldwide distribution of the genera *Polycelis* (subgrenera : *Polycelis* and *Ijimia*) and *Seidlia* is shown in Fig. (see KAWAKATSU, OKI, TAMURA, TAKAI, YAMAMOTO, NISHINO, TIMOSHKIN, KUZNEDELOV & SLUYS, 1996 : 16, fig. 22).

J A P A N

Polycelis (Polycelis) sapporo (IJIMA et KABURAKI, 1916). *Olim Sorocelis sapporo* : IJIMA & KABURAKI (1916: 166–167, figs. 19–20); KABURAKI (1922: 32–39, fig. 11, pl. I, fig. 12). Cf. KENK (1953, 1974 : 57); HYMAN (1934); OKUGAWA (1938) ; KAWAKATSU, YANAGITA, TESHIROGI & ICHIKAWA (1974).

Distribution. The lowland, hilly and low mountain districts of Northern Japan (from Aomori Pref. located in the northernmost part of Honshû to the entire region of Hokkaidô (KAWAKATSU & TIMOSHIKIN, In press, fig. 1). The species is also recorded from South Sakhalin (PORFIRJEVA & SABITOVA, 1986 ; PORFIRJEVA, 1990). OKUGAWA's (1953) records in the Middle and South Kuril Islands are uncertain. For other distribution data, see KAWAKATSU & TIMOSHIKIN (In press).

Seidlia auriculata (IJIMA et KABURAKI, 1916). *Olim Polycelis auriculata* : IJIMA & KABURAKI (1916: 167–169, figs. 21–22); KABURAKI (1922: 39–43, figs. 12–13, pl. I, figs. 13–14). Cf. KENK (1953 : 172 ; 1973 ; 9, 11–13, figs. 6 D, 9 ; 1974 : 54) ; KAWAKATSU, TESHIROGI & ISHIDA (1980).

Distribution. Mountain districts of Central and Northern Japan (from central part of Honshû to the Daisetsu Mts. of Hokkaidô) (KAWAKATSU, YAMADA, MURAYAMA & NAOKI, 1991 : 356, fig. 1 ; see also KAWAKATSU, OKI, TAMURA, OGREN, YAMADA & MURAYAMA, 1990: 12, fig. 21); KAWAKATSU (1965a, 1967, 1969, 1974); KAWAKATSU, TESHIROGI & ISHIDA (1980). The record of this species in South Sakhalin (DYGANOVA & PORFIRJEVA, 1990 : 59–61, figs. 31– 32) is doubtful.

Seidlia akkeshi (ICHIKAWA et KAWAKATSU, 1963). *Olim Polycelis akkeshi* : ICHIKAWA & KAWAKATSU (1963 : 2–15, figs. 1–7). Cf. KENK (1974 : 54).

Distribution. The southeastern, northeastern and central parts of Hokkaidô (KAWAKATSU, 1969 : 74–75, fig. 14, p. 91, pl. VIII, fig. 13).

Seidlia schmidti (ZABUSOV, 1916). *Olim Rjabu schinskya schmidti* : ZABUSOV (1916 : 273–286, figs. 1–5) ; *Polycelis ijimai* (KABURAKI, 1917 ; 327–331, figs. 1–2 ; see also KABURAKI, 1922: 43–47, fig. 14, pl. I, fig. 15). Cf. ZABUSOVA (1936) ; LIVANOV & ZABUSOVA (1940) ; ZABUSOVA-ZHDANOVA (1956, 1960) ; KENK (1953, 1974, 1989) ; KAWAKATSU (1964) ; KAWAKATSU & YAMADA (1966a).

Distribution. The vicinity of Lake Shikotsu-ko, the Lake Akan-ko area, the Shiretoko Peninsula, the Mts. Daisetsu area, the Kitami Mts., the Teshio Mts., and Rishiri Island, in Hokkaidô (KAWAKATSU & TIMOSHIKIN, 1998 : In press, fig. 2). The species is also recorded from South Sakhalin (ZABSOVA-ZHDANOVA, 1960 ; DYGANOVA & PORFIRJEVA, 1990), Primorskiy and Habarovsk in the Russian Far East (PORFIRJEVA & TIMOSHKIN, 1984) ; the Chukotskiy (Chukotskia) Peninsula (ZABUSOVA-ZHDANOVA, 1960 ; PORFIRJEVA & TIMOSHKIN, 1980 ; see also DYGANOVA & PORFIRJEVE, 1990), the Kamchatka Peninsula (ZABUSOVA, 1929, 1936 ; ZABUSOVA-ZHDANOVA, 1956; PORFIRJEVA, UMYLINA & SHCHEGLOVA, 1979), and Bering Island in the Komandorskiye Islands. MIYADI's (1937) and OKUGAWA's (1953) records of this species from the Kuril Islands could not be confirmed. For other distribution data, see KAWAKATSU & TIMOSHKIN (In press).

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Polycelis (Polycelis) elongata (ZABUSOVA, 1929). *Olim Sorocelis (Sorocelides) elongata* : ZABUSOVA (1929: 518–521, figs. 8–9, pl. 4, fig. 4). Cf. KENK (1953: 172; 1974: 55). Syn. *Sorocelis relicta* ZABUSOVA, 1929 ; *Sorocelis eudendrocoeloides* ZABUSOVA, 1929 ; *Polycelis polyopsis* ZABUSOVA, 1936 ; *Seidlia eurantron* ZABUSOVA, 1936 (cf. DYGANOVA & PORFIRJEVA, 1990 : 64–66, figs. 34–35).

Distribution. Sakhalin and Kamchatka; Bering Island (ZABUSOVA-ZHDANOVA, 1956 ; PORFIRJEVA & SHCHEGLOVA,

1979 ; PORFIRJEVA, UMYLINA & SHCHEGLOVA, 1979; DYGANOVA & PORFIRJEVA, 1990). This is a non-pigmented species ; the posterior half of the bursal stalk has a thick muscular coat consisting of circular muscle fibers.

? *Polycelis karafto* IJIMA et KABURAKI, 1916. IJIMA & KABURAKI (1916 : 169–171, figs. 23–24, pl. I, fig. 16); KABURAKI (1922 : 47–49, pl. I, fig. 16). Species inquirenda. Cf. KENK (1953 : 172 ; 1974 : 55).

According to the taxonomic descriptions of this species from the vicinities of Yuzhno-Sakhalinsk (Toyohara) and Korsakov (Ôdomari or Korsakoff) in IJIMA & KABURAKI (*loc. cit.*) and KABURAKI (*loc. cit.*), its external appearance is somewhat similar to that of *S. schmidti*. Although a thick muscle zone of the male genital antrum is not found in the simple schematic figure of the sagittal view of the copulatory apparatus (IJIMA & KABURAKI, 1916: 170, fig. 24), it is highly probable that *Pol. karafto* was named and described from a non-fully matured animal of *S. schmidti*.

PRIMORSKIY and HABAROVSK, RUSSIA, etc.

Dr. TIMOSHIKUN has a sample (slides) of *Polycelis* sp. from Upper Ussury station (see KAWAKATSU, OKI, TAMURA, YAMAMOTO, NISHINO, TIMOSHIKIN, KUZNEDELOV & SLUYS, 1996: 13, fig. 17) ; KAWAKATSU has not yet identified this sample. Recently, a few specimens of *Polycelis* sp. were collected by Mr. N. INOUE in a tributary in the vicinity of Habarovsk (Sept. 4, 1997 : KAWAKATSU's Specimen Lot No. 2285); *Phagocata* sp. (KSL No. 2284) also occurred. There are no records of identified species of *Polycelis* and /or *Seidlia* in the Habarovsk area and the Korean Peninsula (KAWAKATSU, 1994: 53, fig. 3; KAWAKATSU & LIU, 1987: 44–46, figs. 1–2).

C H I N A

Until recently, only 2 described (of which one named only by external appearance of non-sexual specimens) and one non-identified *Polycelis* species were known in China (ZABUSOV, 1911 ; KATÔ, 1950). In his 1993 book, LIU reported 5 new *Polycelis* species from China (see also LIU, 1994a, b, c, 1995). LIU (1996) also reported 3 additional new *Polycelis* species (of which one was placed in the genus *Seidlia* by KAWAKATSU, 1996) from China. These taxonomic papers cited above were published mainly in Russian, Japanese or Chinese. For Chinese species, KAWAKATSU (1994, 1996) published English corrective papers including reproductions of Chinese descriptions and figures of LIU's (*op. cit.*) 8 species.

Polycelis (*Polycelis*) *wutaishanica* LIU, 1993. *Olim Polycelis wutaishanica*: LIU (1993: 160, 162, 166–170, figs. 1–4; 1996: 389–391, figs. 1–2, 397, pl. 1, figs. 1–4). Cf. KAWAKATSU (1994: 53, 55, 58, 60–61, figs. 3, 5-1, 6-1).

Distribution. Shanxi (Shanshi) Province, Northeastern China (LIU, 1993, 1994b, c, 1996 ; KAWAKATSU, 1994, 1996). *Polycelis* sp. from Shanshi reported by KATÔ (1950 : 189, fig. 3) is probably conspecific with this species (KAWAKATSU & LIU, 1987 : 45, fig. 1).

Polycelis (*Polycelis*) *jinglensis* LIU, 1996. *Olim Polycelis jinglensis* : LIU (1996 : 391–393, figs. 3–4, 397, pl. 1, figs. 5–8). Cf. KAWAKATSU (1996 : 1–7, figs. 2-1, 3-1, 4).

Distribution. Mt. Tianzhu and Qingchayan, Jingle Counties, Shanxi Province, Northeastern China (LIU, 1996; KAWAKATSU, 1996).

Polycelis (*Polycelis*) *jingyuanica* LIU, 1996. *Olim Polycelis jingyuanica* : LIU (1996 : 393–394, figs. 5–6, 398, pl. II, figs. 1–4). Cf. KAWAKATSU (1996 : 1–7, figs. 2-2, 3-2, 4).

Distribution. Laolongtan and Xixia Jingyuan Counties, Ningxia Huiz Autonomous Region, Central China (LIU, 1996 ; KAWAKATSU, 1996).

Seidlia hamica (LIU, 1996). *Olim Polycelis hamica* : LIU (1996 : 394–396, figs. 7–8, 398, pl. II, figs. 5–8). Cf. KAWAKATSU (1996 : 1–7, figs. 2-3, 3-3, 4).

Distribution. Baishan of Qincheng, Hami County, Xinjiang Uygur Autonomous Region, Northwestern China (LIU, 1996 : KAWAKATSU, 1996).

Polycelis (*Polycelis*) *koslowi* (ZABUSOV, 1911). *Olim Sorocelis koslowi*: ZABSOV (1911: 345–348, pls. II, fig. 4, XI, fig. 3). Cf. KENK (1953 : 172 ; 1974 : 55).

Distribution. Xizang Autonomous Region (Tibet), Southwestern China (ZABUSOV, 1911; PORFIRJEVA, 1960 : 122–131, figs. 1–2; DYGANOVA & PORFIRJEVA, 1990: 72–74, fig. 43 ; KAWAKATSU, 1994 : 53, 64, figs. 3, 7).

Sorocelis tibeticva ZABUSOV, 1911, is a species inquirenda reported from Tibet ; its genital anatomy is not known (ZABUSOV, 1911 : 349–350, pl. II, fig. 1 ; see KENK, 1974 : 57; KAWAKATSU, 1994 : 64, 67, fig. 7). Judging from the external morphology of this species in the original description, it is highly probable that *Sor. tibetica* [nec *Polycelis tibetica* HYMAN, 1934] is a synonym of *P.* (*P.*) *koslowi*. *Polycelis* sp. from Nepal (ICHIKAWA & KAWAKATSU, 1964 : 27–29, figs. 1–3) may be a synonym of *P.* (*P.*) *koslowi*.

Polycelis (*Polycelis*) *sinensis* LIU,1993. *Olim Polycelis sinensis* : LIU (1993 : 154, 156, 160, 162 –163, fig., 172–174, fig. 1). Cf KAWAKATSU (1994 : 53, 55–56, 58, 60–61, 64, figs. 5-2, 6-2, 7).

Distribution. Xizang Autonomous Region, Southwestern China (LIU, 1993, 1994b, c, 1995 ; KAWAKATSU, 1994).

Polycelis (*Polycelis*) *lhunzhubica* LIU, 1993. *Olim Polycelis lhunzhubica* : LIU (1993 : 160, 162–163, fig., 174–175, fig. 2). Cf. KAWAKATSU (1994 : 53, 56, 59–60, 62, figs. 3, 5-3, 6-3, 7).

Distribution. Xizang Autonomous Region, Southwestern China (LIU, 1993, 1994b, c, 1995 ; KAWAKATSU, 1994).

Polycelis (*Polycelis*) *nyingchica* LIU, 1993. *Olim Polycelis nyingchica* : LIU (1993, 161–63, fig., 176–178, figs. 1–2). Cf. KAWAKATSU (1994 : 53, 56, 59–60,

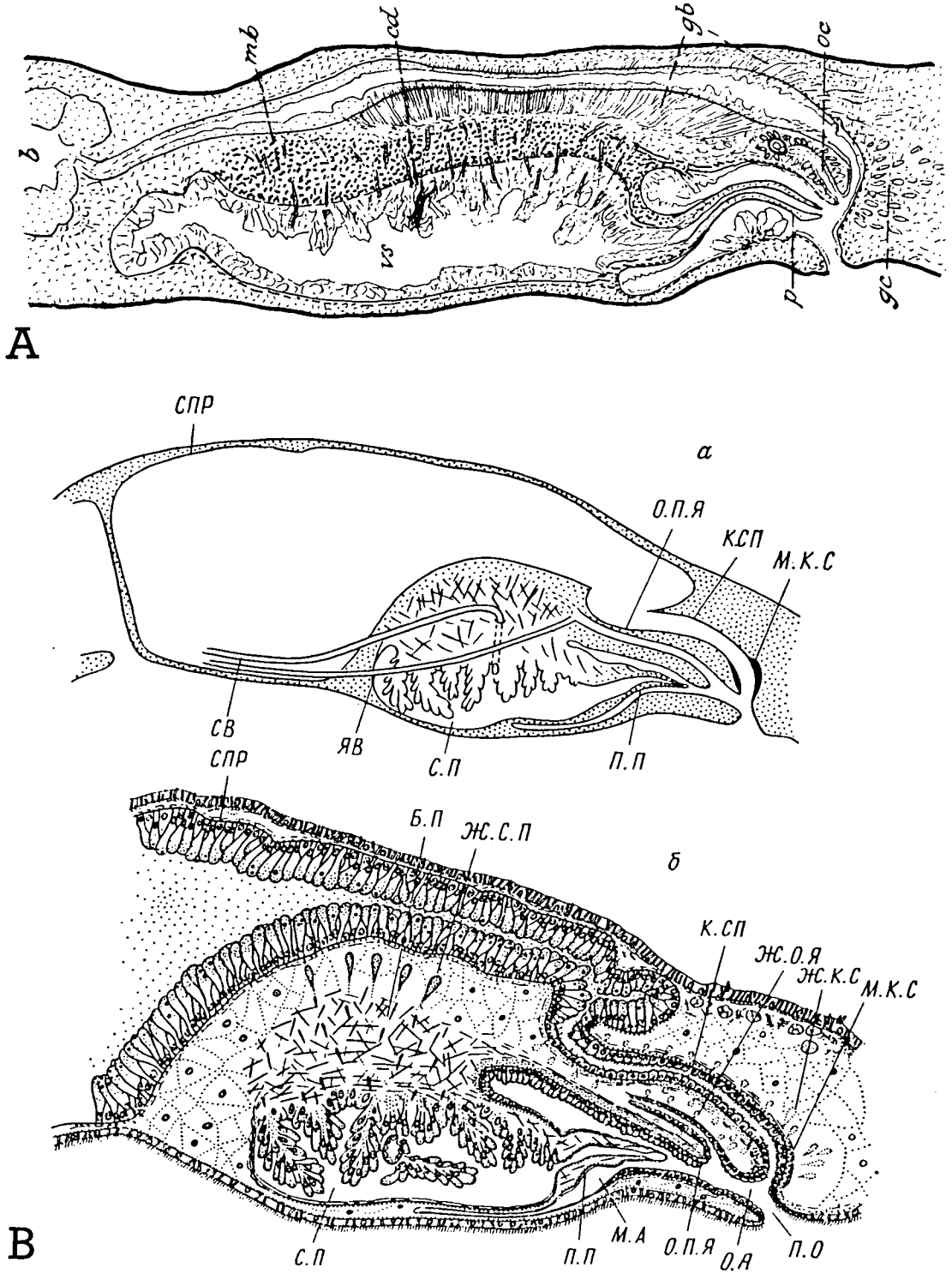

Fig. 6. Sagittal views of the copulatory apparatus of *Polycelis* (*Polycelis*) *pathan* DE BEAUCHAMP, 1959. A (top), *Polycelis pathan* from Afghanistan (after DE BEAUCHAMP, 1959) ; B (middle and bottom), "*Polycelis asiatica*" from Tadzhikistan (after SELIVANOVA, 1985). Only French abbreviations are given. b, bourse copulatrice ; cd, canal déférent ; gb, glandes de la bourse ; gc, glandes de l'atrium ; mb, musculature bulbaire ; p, pénis ; vs, vésicule séminale.

64, figs. 3, 5-4, 6-4, 7).

Distribution. Xizang Autonomous Region, Southwestern China (LIU, 1993, 1994a, b, c; KAWAKATSU, 1994).

Polycelis (*Polycelis*) *xigazensis* LIU, 1993. *Olim polycelis xigazensis*: LIU (1993, 161-163, fig., 176-180, figs. 3-4). Cf. KAWAKATSU (1994: 53, 56, 59-60, 63-64, figs. 3, 5-5, 6-5, 7).

Distribution. Xizang Autonomous Region, Southwestern China (LIU, 1993, 1994a, b, c, KAWAKATSU, 1994).

Mr. LIU's 4 *Polycelis* species reported from Tibet show striking resemblances to one another. The genital anatomy and histology of *Pol.* (*P.*) *sinensis* are the same as those of *Pol.* (*P.*) *lhunzhubica*. Moreover, *Pol.* (*P.*) *nyingchica* is probably a synonym of *Pol.* (*P.*) *koslowi*. These problemes will await future study.

Polycelis (*Polycelis*) *kashimirica* LIU, 1993. *Olim Polycelis tibetica* HYMAN, 1934 [nec *Sorocelis tibetica* ZABUSOV, 1911]. Cf. HYMAN (1934: 7-11, pls. I, figs. 1-8, II figs. 1-5); KENK (1953: 172; 1974: 57); LIU (1993: 181-182); KAWAKATSU (1994: 53, 64-66, figs. 3, 7).

Distribution. Kashmir (Indian Tibet) (HYMAN, 1934: KAWAKATSU, 1994). The genital anatomy and histology of this species have great resemblance to those of *Pol.* (*P.*) *koslowi* from Tibet.

NEPAL

Polycelis sp. (spp. ?) and /or *Seidlia* sp. (spp. ?) of Nepal. Non-identified samples in KAWAKATSU's Collection.

During the past 35+ years, KAWAKATSU obtained a considerable number of preserved specimens of *Dugesia* sp. (spp. ?) and *Polycelis* sp. (spp. ?) and /or *Seidlia* sp. (spp. ?) collected by many friends in the Kingdom of Nepal (cf. KAWAKATSU, YONEDA & MURAYAMA, 1996a: 95-103, fig. 1; 1996b; 1-4, figs. 1-7) (alt. 1525-4300 m). Several additional samples from the Khumbu Himal area (alt. 2440-4755 m) were also received from Dr. A. OHTAKA. All of these samples sent to Dr. R. SLUYS will be studied with him.

TADZHIKISTAN; KAZAKHSTAN and AFGHANISTAN (CENTRAL ASIA)

Polyselis (*Polycelis*) *pathan* DE BEAUCHAMP, 1959. *Olim Polycelis pathan*: DE BEAUCHAMP (1959: 37-42, figs. 6-8). Cf. KENK (1974: 56). Syn. *Polycelis asiatica* SELIVANOVA, 1985. syn. nov. Cf. SELIVANOVA (1985: 820-826, figs. 1-2). (For comparison of the sagittal views of the copulatory apparatus of this species, see Fig. 6A and

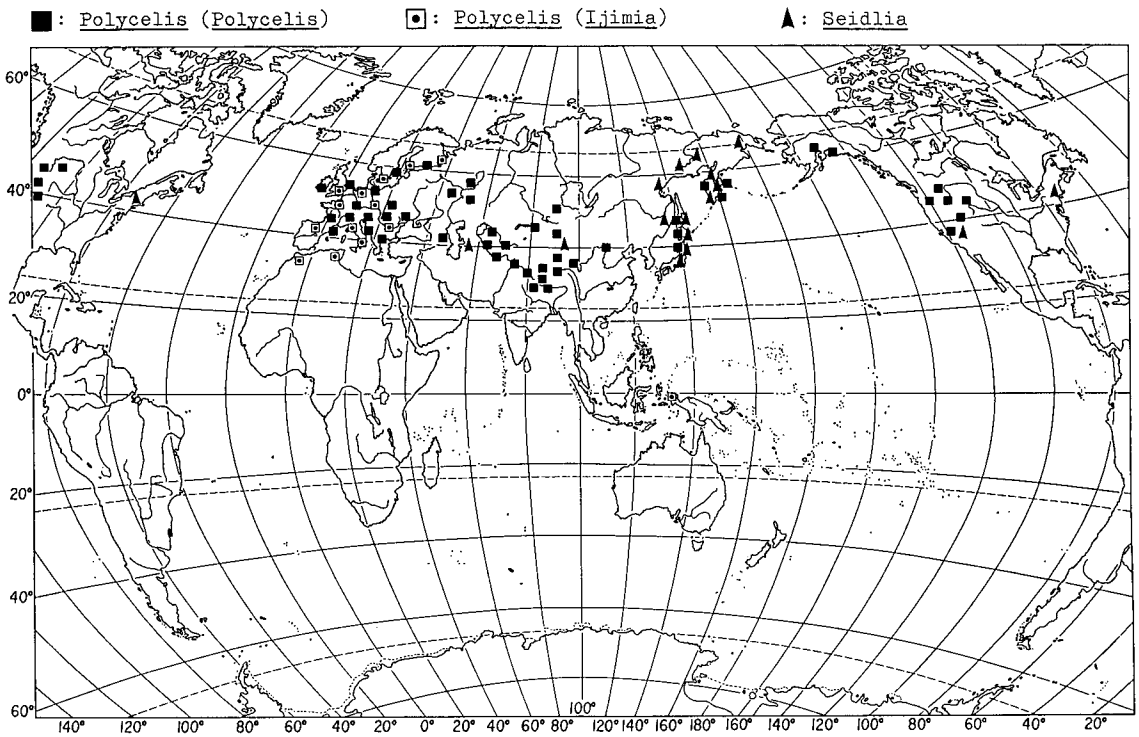

Fig. 7. Worldwide distribution of the genera *Polycelis* EHRENBERG, 1831 (subgenera *Polycelis* EHRENBERG, 1831, and *Ijimia* BERGENDAL, 1890) and *Seidlia* ZABUSOV, 1911. (After KAWAKATSU, OKI, TAMURA, TAKAI, YAMAMOTO, NISHINO, TIMOSHKIN, KUZNEDELOV & SLUYS, 1996; modified.)

B in the present paper.)

Distribution. Afghanistan and Tadzhikistan (Tadjikistan) (KAWAKATSU, 1973 : 80, fig. 1 ; DYGANOVA & PORFIRJEVA, 1990 : 74–75, fig. 44).

Polycelis (*Polycelis*) *pamirensis* DE BEAUCHAMP, 1961. *Olim Polycelis pamirensis* : DE BEAUCHAMP (1961 : 78–85, figs. 1–3) ; ICHIKAWA & KAWAKATSU (1966 : 176–179, 182–187, figs. 1–6). Cf. KENK (1974 : 56).

Distribution. Afghanistan (ICHIKAWA & KAWAKATSU, 1966; KAWAKATSU, 1973: 80, fig. 1). *Polycelis* sp. from Northern Pakistan (KAWAKATSU, 1973 : 82–83, figs. 2 C–E, 3 D, 88–89) is probably conspecific with this species.

Seidlia sabussowi (SEIDL, 1911). *Olim Sorocelis sabussowi* : SEIDL (1911 : 36–64, pls. V–VIII, figs. 6, 11–12). Cf KENK (1953: 172; 1974: 56–57). Syn. *Sorocelis stummeri* SEIDL, 1911; *Sorcelis lactea* SEIDL, 1911; *Seidlia alma-atina* ZABUSOVA-ZHDANOVA, 1947. Cf. SEIDL (1911); ZABUSOV (1911); ZABUSOVA-ZHDANOVA (1947: 153–160, figs. 1–3); DYGANOVA & PORFIRJEVA (1990: 62–63, fig. 33).

Distribution. Karakul' in Tadzhikistan and Kazakhstan.

Polycelis (*Poliycelis*) *kulsaika* ZABUSOVA-ZHDANOVA, 1947. *Olim Polycelis kulsaika* : ZABUSOVA-ZHDANOVA (1947: 160–164, figs. 4–6). Cf. KENK (1974 : 55).

Distribution. Kazakhstan (PORFIRJEVA, 1960: 131–138, figs. 3–4).

KAVKAZ, RUSSIA (CENTRAL ASIA)

Polycelis (*Polycelis*) *eburnea* (MUTH, 1912). *Olim Sorocelis eburnea*: MUTH (1912: 387–408, figs. 1–2). Cf. KENK (1953: 172; 1974: 54–55).

Distribution. Kavkaz, Russia (PORFIRJEVA, 1960; DYGANOVA & PORFIRJEVA, 1990: 70–72, fig. 41).

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SUMMARY

"*Polycelis remota* SMITH, 1988," described from a spring in western Massachusetts, is a medium-sized, pigmented species. From the results of the microscopic examination of newly-prepared serial sections of animals from the type locality, the species has a small penis papilla projecting into the beginning of the long, tubular male genital antrum that is surrounded by a thick, highly muscular coat (penis sheath). The species should be classified as *Seidlia remota* (SMITH, 1988).

The taxonomic notes on *Seidlia* and *Polycelis* species from the Far East and Central Asia were given in the second section. "*Polycelis asiatica* SELIVANOVA, 1985," from Tadzhikistan should be considered as a synonym of *Polycelis* (*Polycelis*) *pathan* DE BEAUCHAMP, 1959, from Afghanistan.

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